



## Chapter 8. Can You Show That the Temperature of Air Has an Effect on Its Weight and Its Direction of Vertical Movement? A Guided-Inquiry Activity

### Think About This!

Have you ever seen leaves on trees turn upward during a summer afternoon breeze? What do you think might cause this to happen? Do you think it might have something to do with change in the density (weight) of the air?



### The Purpose

*This activity has two important purposes. It is designed to challenge the learner to develop a procedure for investigating a research question and to learn more about factors affecting the dynamics of air in motion.*

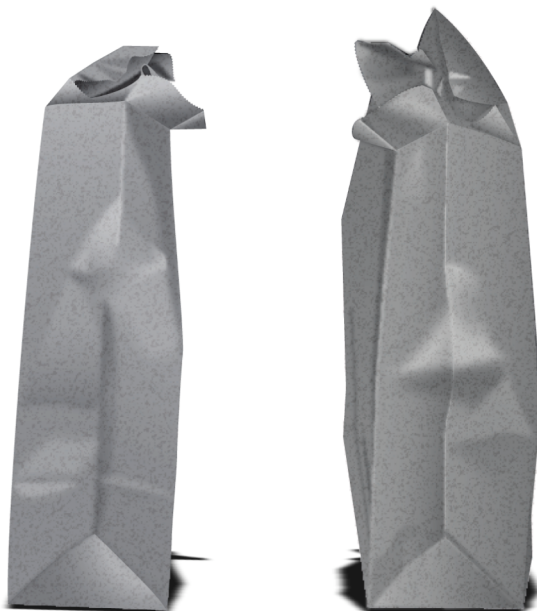


Figure 8-1. What is inside these bags?

### Objectives for the Learner (Essentials of Inquiry)

Carefully look at the two paper bags in Figure 8-1. If you were to look inside these bags, you would not be able to see anything. However, there is something inside these bags that is not visible. Do you know what is inside these bags? How do you know? What is the evidence?

*Because the bags are three-dimensional and not flat, something is keeping them from collapsing. This “something” is air. The air inside is equal in pressure to the outside air surrounding the bags.*

Your challenge, under the supervision of your teacher, is to design an investigation by which you provide some concrete evidence that warm air and cool air differ in weight and this difference affects air’s vertical movement.

Try to address the following essence of science as inquiry:

**Conceptual Theme:** To determine that a change in temperature of air affects its vertical movement.

**Content:** Developing an investigation proving that warm air and cold air vary in density and vertical movement.

**Skills:** The focus is on using laboratory equipment, making careful observation, recording physical changes, drawing conclusions, and describing and communicating results.

**Scientific Habits of Mind:** The importance of careful observations, respect for data, verifying results and conducting experiments safely.

## Materials

A ring stand or device  
on which to balance a beam  
(same as used in Chapter 7)

Beam (ruler or wooden stick)

Paper bags

Hangers (paper clips)

A lamp with 100-watt  
or higher wattage bulb

Non-mercury thermometer

Clear tape



## Preparation

Provide the equipment listed above for each student or group of students but without telling them how to assemble it or how to design the investigation. Provide other simple materials requested by students.

## For the Teacher

**NOTE:** This activity requires patience and skill to balance the two paper bags. It is important that the paper bags are balanced before the light is turned on and directed toward one of the bags. Younger learners might experience difficulty in balancing the two bags. A lamp with a 100-watt or higher wattage bulb works best to warm the air inside the bag. Caution should be exerted not to set the light too close to the paper bag, because the heat could cause a fire. Also, it should be noted that due to the small mass of air in each bag, the scale might tip only slightly in the direction of the nonheated bag.

*In a Guided-Inquiry Activity, the learner is given the question to investigate but he/she must design an appropriate procedure to carry out the investigation.*

*The challenge for the teacher is in fulfilling the role of a teacher to aid the student in constructing his/her own design without too much external directing. Naturally, there are many procedures that can lead to a valid resolution of the presented question.*

*The illustrations (Figures 8-2 and 8-3) should not be shared with the learner, because in a Guided-Inquiry Activity, the learner constructs the procedure. They should assist the teacher in guiding the learner toward an appropriate design.*

*Encourage the learner to be creative in the procedure design. For example, the experiment could be repeated more than once and results compared. Another variation could be to switch the light from one of the bags to the other to see if this makes a difference.*



**Figure 8-2. Balanced bags.**



**Figure 8-3. One bag receiving direct light.**

*In Figure 8-2, the two bags are balanced. In Figure 8-3, the bag receiving the direct light has risen slightly.*

*To further enhance the students' understanding of the role of density and its influence on the movement of air, they might be referred to the activity in Appendix VII entitled The Mysterious Snake.*

### **Possible Outcome and Conclusion**

*Because the bags allow air to escape, a possible and logical conclusion might be that the more direct heat on the bag caused the air inside to warm and expand. Some of the air in the bag escaped to the surrounding environment. The air inside the warmed bag became less dense (weighed less) than the air inside the other bag and caused the imbalance. Accept reasonable explanations from the learners and try to help them see any of their misconceptions.*

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